Do charges to freight trucks and trains in the European Union reflect their social marginal costs? Application to the case of Spain

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Abstract

In the last few years, the European Union (EU) has become greatly concerned about the environmental costs of road transport in Europe as a result of the constant growth in the market share of trucks and the steady decline in the market share of railroads. In order to reverse this trend, the EU is promoting the implementation of additional charges for heavy goods vehicles (HGV) on the trunk roads of the EU countries. However, the EU policy is being criticised because it does not address the implementation of charges to internalise the external costs produced by automobiles and other transport modes such as railroad. In this paper, we first describe the evolution of the HGV charging policy in the EU, and then assess its practical implementation across different European countries. Second, and of greater significance, by using the case study of Spain, we evaluate to what extent the current fees on trucks and trains reflect their social marginal costs, and consequently lead to an allocative-efficient outcome. We found that for the average case in Spain the truck industry meets more of the marginal social cost produced by it than does the freight railroad industry. The reason for this lies in the large sums of money paid by truck companies in fuel taxes, and the subsidies that continue to be granted by the government to the railroads.

INTRODUCTION

Using road pricing as a means of allocating resources to optimise social welfare when congestion and other externalities occur has been discussed for many decades in the literature. In 'The Economics of Welfare', Pigou (1920) introduced the possibility of setting up prices to internalise the externalities of a given activity. In the transport arena, this approach has been particularly focused on pricing congestion in urban areas. However, in the last few years, there has been a growing trend towards the implementation of charges as a means of

internalising the externalities produced by trucks on interurban roads (Suter & Walter 2001; Parry & Small 2005; Calthrop, de Borger & Proost 2007; Parry 2008). This trend has prompted the development of new technologies to track even more closely the actual usage of roads (Sorensen & Taylor 2005).

The market share of road freight transport in the European Union (EU) has been steadily growing over the past decades whereas rail freight has been gradually declining (Vassallo & Fagan 2007). According to the most recently available freight transport statistics, the market share of rail transport in the EU-27[1] in tonne-km accounted for only 17.8% (European Commission 2011) compared with 38.5% in the United States (US DOT 2011). Consequently, the EU has been increasing its efforts to find ways to promote cleaner transport modes such as railroad, barge and short sea shipping (Ribbink, van Riel & Semeijn 2005). This paper is focused in one of the measures adopted to curb this trend: the introduction of charges for heavy goods vehicles (HGVs).

In the last few years, the EU has been paving the way to implementing charges to HGVs in Europe, and some countries have already adopted this approach. Switzerland, even though it is not a member of the EU, has been charging HGVs above 3.5 tonnes on all their roads since 2001. Austria and Germany moved a few years ago to a distance-based charging approach for HGVs over 12 tonnes. Recently, the Czech Republic and Slovakia adopted similar approaches. Many other countries in Europe are following this lead (Chlan 2008; Knoflacher 2001; Suter & Walter 2001). However, the implementation of this policy has been disputed by different stakeholders for several reasons. First and foremost, truckers claim that fuel taxes in Europe are discriminatory in the sense that they are levied only on the fuel consumed by road transport, but not on the fuel consumed by other transport modes. Second, fuel taxes for road transport are not homogeneous throughout Europe. And third, peripheral countries claim that charging HGVs can potentially damage their economies by increasing their transport costs more than the central regions'.

There are three objectives of this paper. First, we describe the evolution of the HGV charging policy in the EU. Second, we assess the practical implementation of this policy in different European countries, and third, and most important, we discuss whether the implementation of fees to HGVs and trains fulfil the principles of allocative efficiency.

1 The 27 member states of the European Union.

To undertake the third objective, we carried out a simple exercise, using Spain as a case study. This exercise consisted in comparing the payments already being made with the marginal social costs for the freight road and rail transport sector. The goal of this exercise was to approximate the fee-charge per tonne-kilometre (tkm) that should be applicable to each mode. It is important to point out that the methodology used in this paper focuses on the impact of pricing on mode share. For the sake of simplicity, we set aside other factors influencing the pricing, such as the choice of road vehicle and route, the decision of load factors, and the impacts over the long term of decisions such as the location of points of production, consumption and intermodal transfer.

In the first section of our paper, after the introduction, we outline the HGV pricing policy in Europe. In the second section, we analyse the experience of pricing HGVs in different European countries. In the third section we use the Spanish case study to compare the social balance of contributions and the external costs. In this section we also discuss the allocative efficiency of the implementation of the HGV charging policy in the EU. We found that the HGV charging policy in Europe would not fulfil the principle of allocative efficiency unless the current discriminatory fuel taxes and rail subsidies are taken into account in the calculation of the fees imposed.

EU POLICY TOWARDS CHARGING HEAVY GOODS VEHICLES

Since 1971 the EU has been trying to establish a policy on pricing infrastructure use. However, the strong opposition to this policy from some Member States and road haulers stopped its progress for a long time (Vassallo 2001). In 1998, the Commission, concerned again with this issue, published the White Paper titled 'Fair payment for infrastructure use: A phased approach to a common transport infrastructure charging framework strategy in the European Union' (European Commission 1998). This paper recommended that Member States carry out a gradual and progressive harmonisation of fee-charging principles for all commercial modes of transport by proposing an approach based on the 'user-pays' principle.

Even though many of the objectives of the White Paper were not fully met due to the opposition of Member States, its publication did prompt some changes in the legislation. Directive 1999/62 'The Charging of Heavy Goods Vehicles for the Use of Certain Infrastructure' (known as 'Eurovignette' Directive) was passed a short time later. The focus of this directive was primarily on the establishment

of mechanisms, either vignettes or tolls, for fee-charging infrastructure costs to hauliers. Tolls are defined as distance-based charges and vignettes are defined as time-based charges. However, this directive did not constitute a great advance. Its main contribution was the implementation of a minimum tax rate on the possession of those vehicles that had an authorised maximum gross laden weight of over 12 tonnes. This Directive also established that trucks should not be subject to double fee-charging (i.e. tolls plus vignettes).

The White Paper 'European transport policy for 2010: time to decide' published in 2001 (European Commission 2001) represented an important milestone in the European transport policy. Its chief objective was to put a new focus on sustainable transport and global strategy by gradually decoupling economic growth from transport growth (Pahaut & Sikow 2006). The White Paper reinforced the principle of paying for infrastructure use as a way of internalising external transport costs, and announced the Commission's intention of proposing a directive on charging fees for the use of road infrastructure. The mid-term review of the White Paper conducted in 2006 (European Commission 2006) paid special attention to the possibility of increasing fee-charges in environmentally sensitive locations and urban areas.

In 2006 the European Union passed the Directive 2006/38/EC amending Directive 1999/62/EC on the charging of HGVs for the use of certain infrastructure. The Directive established that such charges are to be applied by 2012 in all the EU countries to commercial vehicles over 3.5 tonnes on the Trans European Transport Network and roads to which traffic can be diverted. However, Member States can exempt trucks below 12 tonnes from such payment if such fees produced significant adverse effects, or transaction costs were higher than 30% of the revenues produced. Member States are free to impose fees for the use of roads other than the trans-European networks.

According to the Directive, charges can be implemented depending on distance, location of the road, damage to the pavement, EURO classification of the vehicle, time of the day, and congestion on the road. Revenues from HGV charges should be used for the maintenance of the infrastructure concerned and for the transport sector as a whole, in order to promote sustainable development of transport networks. The Directive set up the principles to charge fees to HGVs, but it has not yet established the specific minimum charge to be applied. In this respect the Directive entrusted the Commission with the mandate to present, no later than June 2008, a 'generally applicable, transparent and comprehensible model' for the assessment of all external costs, a model that is intended to serve as the basis for future calculations of infrastructure charges. The Commission entrusted the task of producing a guide to assess external transport costs to a group of universities and research institutes coordinated by the University of Delft. Regarding discriminatory fuel taxes, the Directive says that any future decision on setting up charges should take full account of the tax burden already borne by road haulage companies, including vehicle taxes and fuel excise duties.

In order to comply with the commitment set out by Directive 2006/38/EC, in July 2008, the Commission issued a communication to Parliament, the Council, the Economic and Social Committee and the Committee of the Regions comprising a model and a 'Strategy for the Internalization of External Costs' (European Commission 2008a). This communication established a framework for internalising the externalities of all transport modes, but it focuses mainly on the road haulage sector. In fact, it was accompanied by a proposal for a Directive of the European Parliament and of the Council amending again Directive 1999/62/EC on the charging of HGVs for the use of certain infrastructure (European Commission 2008b). This proposal, which has not been passed yet, seeks to establish a framework to enable Member States to calculate and vary tolls for HGVs on the basis of the costs of traffic pollution and congestion in a way compatible with the internal market. The proposal provides a set of tables that establish guidelines of how to charge HGVs for pollution, noise and congestion.

Several aspects of the European policy regarding the implementation of the infrastructure charging policy in the EU are worth noting. First, while the initial steps towards the implementation of this policy considered all transport modes, including cars and coaches for the road, Directive 2006/38/EC applies only to HGVs, leaving aside other transport modes such as rail, air, and maritime transport, as well as other vehicles such as cars and coaches. Even though, the Strategy for the Internalization of the External Costs states that all transport modes should be considered, it turns out to be stricter with HGVs than with other transport modes, and even with cars or coaches. For instance, the Strategy states that even though the charging principle should be extended to cars, Member States retain the freedom whether to do so or not (European Commission 2008a). The Strategy also states that charges to internalise external costs in the rail sector

would be applicable only if there was an equivalent increase in the charges applied to competing modes of transport.

ACTIONS ADOPTED BY THE EUROPEAN COUNTRIES

There are, with respect to interurban road charging, three distinct groupings of countries in Europe. First, there are countries that have historically used tolls—for both cars and trucks—in parts of their trunk network: France, Italy, Portugal and Spain and, more recently, countries such as Greece, Croatia, Hungary, Poland and Slovenia. Those tolls were not established in order to internalise externalities but, rather, viewed simply as a means of raising money to privately fund new highways. Second, there are some countries, in particular Belgium, Netherlands, Luxembourg, Denmark, Sweden and Poland, that, since the 1990s, have implemented a fixed charge, called 'vignette', for HGVs based on time rather than distance. Germany implemented this mechanism until 2005, when it changed to the present electronic toll collection system that will be described later. The main reason why these countries implemented this measure was to be able to impose fees on foreign trucks for the use of their domestic road networks. Finally, there are countries that in the last few years have introduced charges for HGVs calculated on the basis of distance travelled: Switzerland from 2001, Austria from 2004, Germany from 2005, the Czech Republic from 2007, and Slovakia from 2010. In this section, we will focus on this latter group since it closely follows the principles established by the EU. A summary of the main characteristics of the pricing approaches of some of those countries is found in *Table 1*.

Switzerland decided to introduce a charging policy for HGVs that was then extended to apply to all interurban roads in 2001 (Suter & Walter 2001), which accounted for over 71 000 km of road. The price is applied to all vehicles of more than 3.5 tonnes on all interurban roads. This is a kilometre charge that varies from 47.6 to 61.2 euro cents per veh-km, according to the weight and emission category of the vehicle. The transaction costs of the fee-charging are about 40 million euros a year, which means approximately 8% of the total revenues produced. In Germany transaction costs are about 15% of the revenues produced. The revenues obtained are distributed between investment in the railroads (2/3) and the general budget of the Swiss cantons (1/3).

At the same time that the HGV price was introduced in Switzerland, the maximum weight limit on trucks was raised from 28 to 40 tonnes. This aligned Switzerland with the HGV mass limit for the EU. The result of the implementation of these two measures was a reduction of 18% in the total road freight transport costs (Balmer 2004), due to both the decrease in truck traffic and the improvement in the efficiency of the remaining truck traffic. The combined strategy implemented in Switzerland had two main consequences. First,

Table 1
Characteristics of the countries that have already implemented a distance-based charge to heavy goods vehicles in Europe

	Vehicles and network charged	Price depends on:	Revenue usage
Switzerland	HGV over 3.5 tonnes All the interurban roads	Maximum laden weight Emission class	2/3 to railroads 1/3 canton budget
Austria	HGVs over 12 tonnes* Highways	Number of axles	Motorways
Germany	HGVs over 12 tonnes Highways	Number of axles Emission class	50% road network 38% railroads 12% inland waterways
Czech Republic	HGVs over 3.5 tonnes Highways and some trunk roads	Number of axles Emission class	Transport infrastructure

* Vehicles between 3.5 and 12 tonnes are charged a vignette.

Data sources: [a] Ministerio de Fomento (2006a), [b] ADIF (2006), [c] Ministerio de Economía (2007), [d] Ministerio de Fomento (2007), [e] RENFE (2008), [f] Pasi (2007).

a notable renovation of the fleet took place since transport operators strived to buy less polluting and larger vehicles to save on costs. Second, mergers among transport companies were encouraged because larger companies were able to benefit from greater economies of scale, in order to manage their fleet more efficiently, for example by diminishing the number of vehicles forced to make return journeys without freight. The changes cited above have resulted in both substantial economic and environmental benefits (Balmer 2004).

In 2005 Germany introduced a HGV pricing system based on distance to replace the vignette. The HGV prices applied in Germany are lower than those applied in Switzerland and, in addition, they have only been put into operation on motorways—approximately 12 000 km long—for trucks over 12 tonnes. This measure has caused a transfer of traffic to smaller vehicles and secondary roads, which implied that the ultimate environmental benefits from the implementation of these charges were less than the benefits originally expected. One of the reasons why Germany pushed the implementation of a fee-charging mechanism is that its roads bear a high percentage of through traffic coming and going to different countries without paying taxes in Germany. The price varies between 9 and 14 euro cents per veh-km, depending on the emission category of the vehicle, the number of axles and the time of day (peak/off-peak). The system includes a compensation mechanism for haulers in the form of subsidies for the purchase of less-polluting vehicles. Freight traffic trends show both a shift towards trucks with better emission standards and a reduction in the share of empty trips. An amount of over 3 billion euros was collected in the past few years, a sum that was then transferred to the 'Transport Infrastructure Financing Company' (VIFG), which is obliged to distribute the revenues among the different modes of transport in the following proportion: 50% for roads, 38% for railroads and 12% for waterways. The cost to the German government for putting the pricing system into operation has been much higher than in Switzerland due to the complex technology used and the problems encountered in its implementation (Link 2005).

Austria has a long tradition of using motorway tolls for keeping trucks from crossing the countryside. Alpine motorways, in particular, have been toll roads since their inception (Knoflacher 2001). In addition, from 1997 to 2004 a vignette was implemented for the use of most of the motorways in Austria. From 2004, a distance-based fee was introduced for HGVs over 12 tonnes, while the original vignette was maintained for vehicles between 3.5 and 12 tonnes. The distance-based fee was charged for the motorway network—approximately 2060 km—but not for alternative trunk roads. As happened in Germany, this caused a shift in heavy traffic to alternative free roads. However, unlike the case in Germany, the Austrian HGV pricing system does not set the charges according to the vehicle's emission category nor does it include incentives for the purchase of low polluting vehicles.

In 2007 the Czech Republic joined the group of countries that implemented a HGV pricing mechanism based on distance (Chlan 2008). Initially, the price was applicable to vehicles with a maximum permissible laden weight of 12 tonnes and above. As of January 2010, charges have been expanded to include vehicles over 3.5 tonnes. The system has been implemented on a network made up of 980 km of highways and 180 km of trunk roads. The average price is similar to that in Germany. On 1 January 2010, Slovakia put into operation its electronic tolling system. The new tolling system applies to all motor vehicles with a total weight over 3.5 tonnes, which must now be equipped with a special on-board unit. The system also covers vast sections of first-class roads through the use of GPS-GSM technology.

Other countries in Europe are also moving towards the implementation of HGV pricing. The British Government, in 2008, was planning to introduce a system of road-user fee-charging for trucks, but recently decided to wait to introduce this charge in the framework of a broader charging system for all categories of vehicles (McKinnon 2006). France has studied the feasibility of pricing HGVs on its national free road network (Quoy 2008), and in 2011 was planning to introduce the 'eco-charge'—the name that the charge will have in France—in 13 000-14 000 km of roads by mid-2013. The Spanish government is also moving towards the implementation of a distance-based charge for trucks, but the opposition by the haulage sector and the impact that the implementation of this charge might have on the competitiveness of peripheral regions are delaying its implementation. This last issue is part of a more complex debate which is beyond the scope of this paper.

IS THE EU CHARGING POLICY ALLOCATIVE EFFICIENT? AN ANALYSIS OF TRUCK VS. RAILROAD TRANSPORT IN SPAIN

Allocative efficiency is a theoretical measure of the benefit or utility derived from a proposed or actual selection in the allocation or allotment of resources (Markovits 1998). In this respect, certain approaches

to pricing are likely to bring about allocations of resources that are more efficient than others (Fare, Grosskope & Lovell 1994). According to economic theory, prices should be set at social marginal cost in order to maximise social welfare. Economists usually recommend short-run marginal costs as the appropriate marginal cost for pricing. However, if transport authorities follow the optimal pricing and investment policy, short-run and long-run marginal costs will be equal to each other and consequently to the price to be charged (Gómez-Ibañez, Tye, & Winston 1999). Moreover, if there are neither economies nor diseconomies of scale, marginal costs will equal average costs and price revenues will cover the authorities' costs. If an industry in a market does not set prices according to marginal cost, the outcome will be an inefficient resource allocation (Elgar and Kennedy 2005). Rail and road transport will compete under the same conditions if they are priced according to their social marginal costs.

One of the main criticisms of the EU infrastructure charging policy lies in the fact that it is focused on HGVs, but it does not address the issue of fees imposed on other modes of transport, such as railroads, to internalise external costs. Paradoxically, trucks pay large fuel taxes while railroads are exempt from them. The aim of this section is to conduct a simple exercise to determine whether imposing fees on truck transport without imposing similar fees on rail transport is likely to lead to an efficient allocation of cargoes between these modes. We conducted this analysis for the case study of Spain where a debate about the implementation of charges on the truck industry is already on going.

For this study, we carried out an economic analysis of the freight road and railroad transport in Spain by comparing the charges already paid by each mode, together with their short-run social marginal costs, in order to approximate the additional charge that, according to the social marginal pricing theory, should be implemented for each one of these modes.

Charges already paid by the road and rail modes

In this subsection, we estimate the charges already paid by the freight rail and road transport modes. We have identified three different types of charges.

- *Infrastructure-use charges* already paid by each transport mode for using the appropriate infrastructure. These infrastructure-use charges are basically highway tolls for trucks, and rail infrastructure fees for railroads. In Spain, 2800 km. of highways are tolled (Ministerio de Fomento 2006a). The European railroad policy requires the unbundling of infrastructure from transport operations. In Spain, a new public entity, called ADIF, has been created to manage railroad infrastructure (ADIF 2006). The ADIF is paid by the railroad transport companies that use the rail infrastructure.
- *Fuel taxes*. These are the taxes that are imposed by the government in a discretionary way. For example, special fuel taxes in Spain are levied only on the fuel consumed by road transport vehicles but not on the fuel consumed by other transport modes such as railroads (Ministerio de Economía 2007). Unlike some countries, such as the United States, fuel tax revenues in Spain are neither totally nor partially earmarked to a trust fund to finance transport investment needs. Instead, fuel taxes go directly into the general revenue. The following special taxes are taken into account in this analysis.

  For the road sector we considered fuel taxes, vehicle ownership taxes and other minor taxes. Fuel taxes in Europe are very high compared to other parts of the developed world. In Spain, which is one of the EU countries with the lowest fuel taxes, diesel taxes are about €30ct/L, whereas in the United States fuel taxes are around €9 ct/L. In other European countries, diesel taxes are even higher: €72 ct/L in the UK, €47 ct/L in Germany and €35 ct/L in Austria.

  For the rail sector we considered special electricity taxes. Freight railroad transport in Spain uses both electrified and non-electrified lines. Trains on non-electrified lines consume diesel, which for railroads, unlike road transport, is not subject to special diesel taxes. However, trains using electrified lines are subject to a special tax levied on electricity usage. Unlike trucks, railroads in Spain are not subject to the special vehicle ownership taxes.
- *Minus operation subsidies*. Freight truck transport in Europe and, therefore, in Spain, was liberalised several years ago so companies offering freight road transport services no longer receive direct subsidies from the government. This is not the case for railroads. Even though the European transport policy is promoting the liberalisation of freight railroad transport services in Europe,

Table 2
Implicit charges paid by trucks and freight railroads in Spain in 2005

Million €	Truck	Railroad
Highway tolls[a]	384.40	
Railroad infrastructure fees[b]		37.10
INFRASTRUCTURE USE FEES [IUF]	384.40	37.10
Fuel tax[c]	3570.60	
Vehicle ownership tax[c]	244.70	
Electricity taxes[c]		4.90
Other special taxes[d]	204.00	
TAXES [ST]	4019.30	4.90
OPERATION SUBSIDIES[e] [OS]		137.30
TOTAL [IUF] + [ST] – [OS]	**4403.70**	**–95.30**
Interurban traffic[f] (10^6 tkm)	233 219.00	11 641.00
IMPLICIT CHARGE (€ct/tkm)	**1.8882**	**–0.8187**

the pace followed by some countries is still slow. A few private companies in Spain have recently received the licence to operate freight railroads, but the bulk of the rail freight transport in Spain is still carried by the public transport operator RENFE, which continues to be subsidised by the government (RENFE 2008). The subsidy included in the calculation relates only to the interurban freight operations of the company.

Table 2 displays a summary of the payments made by trucks and freight railroads in Spain. These payments indicate an implicit charge for trucks and an implicit subsidy for railroads, which has to be taken into account in the analysis intended to arrive at the calculation of fees or charges for HGVs. The implicit charge per tonne-km is calculated by dividing the total contributions, calculated only for the interurban network, by the interurban traffic.

External transport costs

External costs are those costs that are not borne by the industry that produces them. If the external costs are not internalised, the outcome is not efficient from the social point of view. The transport sector produces important externalities such as noise, accidents, congestion, emissions and so on, which are not borne by the transport operators themselves, but by the society.

Although there is general agreement that pollution, noise, carbon emissions and so on constitute an important external cost for society, there is a total lack of agreement on the monetary evaluation of these costs. Quinet (2004) conducted a meta-analysis that tried to evaluate the volatility on the calculation of transport external costs by comparing different studies. The conclusion of Quinet's study offered a wide range of results, which shows the lack of consensus among researchers on the economic evaluation of these costs. Other studies highlight the same outcome for the value to be given for an emitted tonne of CO_2. For instance, Monzón, Fernández and Jordá (2007) show that reliable studies propose values between €1 and €200 per CO_2 tonne. Given the huge variation in these estimates of value, it seems that providing an accurate value for the external transport costs is a difficult issue.

In spite of the difficulties in assigning an economic value to transport externalities, this is necessary for establishing a charge applicable to different transport modes. This is the reason why Directive 2006/38/EC (The Charging of Heavy Goods Vehicle for the Use of Certain Infrastructures) entrusted the Commission with the task of preparing a transparent and comprehensible model for the assessment of external costs for all modes of transport. This model was intended to be the basis for implementing policies aimed at internalising external costs. The first version of the model, called 'Handbook on the Estimation of External Costs in the Transport Sector', was entrusted to a group of universities coordinated by the University of Delft (Maibach et al. 2008). The values of the transport costs provided by this study are similar to the values reported by other

Table 3
External cost values (€ct) per tonne·km in 2005

	TRUCK			TRAIN		
	Min.	Most probable	Max.	Min.	Most probable	Max.
Noise	0.030	0.130	0.170	0.118	0.160	0.490
Accidents	0.020	0.230	0.299	0.020	0.023	0.086
Air pollution	0.500	0.730	1.829	0.264	0.292	0.620
Climate change	0.051	0.190	0.342	0.024	0.087	0.159
Congestion	0.000	0.959	6.849	0.000	0.035	0.071
Up and downstream processes	0.100	0.230	0.573	0.075	0.121	0.248
Nature & landscape	0.000	0.080	0.098	0.000	0.020	0.022
Soil and water pollution	0.020	0.080	0.092	0.020	0.020	0.020
Infrastructure maintenance	0.200	0.288	0.350	0.035	0.107	0.178
TOTAL	0.921	2.917	10.602	0.556	0.865	1.894

studies in Europe (Quinet 2004; Heaney, O'Mahony & Gibbons 2005; Bickel et al. 2006; Janic 2007). American studies tend to show lower values for transport externalities of about 0.015 €/tkm for trucks (Forkenbrock 2001; TRB 1996).

In order to calculate transport externalities in Spain, we basically used the methodology provided by the 'Handbook on the Estimation of External Costs in the Transport Sector' (Maibach et al. 2008) that makes a calculation of the social marginal costs for cars, trucks and trains per veh·km and train·km. We have adapted this methodology to the case of interurban freight road and rail transport in Spain. To that end, we have used the load factors of freight transport in Spain of 7.3 net tonnes/vehicle for trucks and 283 net tonnes/train. These values include the average for all types of freight vehicles including empty returns. As 70% of freight railroad transport in Spain uses electric trains and 30% relies on diesel trains, the last column of *Table 3* shows a weighted average social cost per tonne·km for trains in Spain. Congestion costs in Spain are not as high as they are in other countries of the EU since most of the interurban road network is rarely congested. For this reason, the average congestion cost in Spain of 0.959 €ct/tkm is less than that in Europe, 4.795 €ct/tkm (Maibach, 2008). However, the congestion costs can increase substantially on the road access to the main cities.

Table 3 shows the results of the estimates of external costs for Spain. Uncertainty issues related with the range of variation in the cost estimates have been addressed with the inclusion of 'minimum', 'maximum' and 'most probable' values given in the Handbook. From the table we observe that congestion and air pollution are the two biggest external costs for trucks, far above climate change. Noise and air pollution are the most important ones for railroads.

We incorporated into the calculations other marginal external costs caused by trucks and freight railroads, such as infrastructure wear and tear, which are not evaluated in the Handbook. For HGVs, we have adopted an average infrastructure maintenance cost of 0.021 €/truck-km (Fang, Ciommo & Monzón 2009). For trains, we followed the comprehensive review by Sánchez (2009), and have selected an interval from 0.35 €/1000 gross tkm (Andersson 2006) to 1.78 €/1000 tkm, as suggested by Wheat and Smith (2008).

Estimation of allocative-efficient surcharges for trucks and trains

Once present charges and external transport costs have been provided for both trucks and trains, *Table 4* explains the way to calculate the average additional charge (surcharge) for both trucks and freight railroads in Spain according to the short-run social marginal cost pricing theory. It is important to underscore that the estimated surcharge is the average one for HGVs and freight railroads. The specific surcharge for each kind of vehicle or train should depend on their characteristics regarding authorised maximum gross laden weight, number of axles, EURO category and so on.

Table 4 shows the additional charges (surcharges) that would be applicable to trucks and the freight

Table 4
Estimates of the average surcharge (€ct) per tonne·km for trucks and railroads in Spain in 2005

Year 2005		Truck	Train
Charge already applied (€ct/tkm) [IC]		1.888	–0.818
Social marginal cost (€ct/tkm) [E]	Min	0.921	0.556
	Most probable	2.917	0.865
	Max	10.602	1.894
Additional charge applicable (€ct/tkm) [E] – [IC]	Min	–0.967	1.374
	Most probable	1.029	1.683
	Max	8.714	2.712
Additional charge applicable per vehicle (€ct/veh·km)	Min	–7.061	388.842
	Most probable	7.510	476.384
	Max	63.613	767.403

railroads to internalise the external costs produced by them to reach allocative efficiency. The surcharges are calculated for three different scenarios of external marginal costs (minimum, most probable and maximum). This surcharge is calculated in a straightforward way as the difference between the social marginal cost [E] for each scenario and the implicit charge [IC]. The external costs are the same ones previously calculated in *Table 3*. The surcharge is first calculated per tonne·km. Then, by applying the load factor for Spain, additional charges are calculated per vehicle·km (see the bottom three rows in *Table 4*).

From this research, we obtained an interesting result. Unlike the general belief in Europe that the social account balance for freight railroads is more positive than it is for trucks, our analysis for Spain shows that the surcharges to be applicable to trucks are lower than those applicable to the railroads for the most probable scenario. The surcharge applicable to trucks in Spain should be 1.029 €ct/tkm for the most probable scenario in terms of externalities, whereas the surcharge applicable to railroads should be about 1.683 €ct/tkm for the same scenario. The reason for this difference lies in both the large contributions that trucks already pay through special taxes, and the subsidies that freight railroads still receive in Spain.

Using average interurban load factors for Spain, it is easy to estimate that the average surcharge to be applied per veh·km for the most probable scenario is about 7.510 €ct/veh·km, lower than the charges that are presently applied in Germany, Austria and the Czech Republic, which are between 10 and 12 €ct/veh·km. These countries have fuel taxes even higher than those in Spain, but they have greater congestion problems than does Spain. Following the same reasoning, the average charge should be around 476.384 €ct/train·km.

The results for the different external cost scenarios show that the surcharges applicable depend very much on the congestion level. If we look at the maximum scenario, characterised by high congestion levels, the surcharge to be applicable for trucks would be about 63.613 €ct/veh·km. However, using the minimum scenario, with no congestion, we obtain the result that trucks are presently overcharged in Spain because the special taxes applied to them exceed the social marginal costs not internalised by them.

DISCUSSION AND CONCLUSIONS

The EU is promoting the implementation of charges for HGVs as a strategy to internalise transport externalities, and encouraging cleaner transport modes. The theoretical foundation for this policy is to maximise social welfare by pricing at the short-run social marginal cost. Although this theory should be applicable to all transport modes, the EU legislation does not address the issue of charging other transport modes and means other than trucks.

In spite of the undoubtedly good intentions of the Commission to promote cleaner transport modes, the application of the EU's HGV charging policy remains debatable, as it does not make sense to implement a charging policy without considering all the transport modes for both passengers and freight. Economic theory shows that pricing a transport mode at the short-run marginal social cost is not

necessarily allocative efficient if competitive modes are not priced at the marginal social cost as well. The case study of Spain shows that if the EU's HGVs policy was implemented in Spain with charges at the levels of other European countries, trucks would be slightly overpriced and railroads would be underpriced in the most probable scenario. This undoubtedly will distort competition. The policy lesson from this research is that freight rail subsidies should be reduced or eliminated while road user charges should be applied taking fuel subsidies into account in its calculation.

The main conclusion of this analysis is that introducing an 'externalities charge' on road transport without charging substitutive modes would distort road–rail competition and lead to an inefficient allocation of cargo between the modes. The calculation of the charges should allow for special taxes, such as fuel taxes, which are applied to different transport modes in a way that discriminates among such modes. It should also take into account the subsidies already allocated to some transport modes.

In addition, the charging policy should reflect the large cost sensitivity resulting from the different levels of congestion in the specific sections of the network where the charges are implemented. The figures obtained in this paper demonstrate that the level of congestion may have a substantial influence on the short-run social marginal cost and consequently on the charge to be applicable.

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